Executive Functions in Aging: An Experimental and Computational Study of the Wisconsin Card Sorting Task

Andrea Caso
Birkbeck, University of London, London, United Kingdom

Richard Cooper
Birkbeck, University of London, London, United Kingdom

Abstract

In this paper we explore the effect of normal aging on executive function and present a computational account of the effect of aging in a standard executive task. We tested 25 younger adults and 25 older adults (both with no known neurological condition) on the Wisconsin Card Sorting Task (WCST), a classic test of executive function. The test produces multiple measures related to the types of error made by participants, the rate of learning, and so on. As hypothesised, results show no difference between the groups in the number of perseverative errors (i.e., in continuing with a previously successful rule in the presence of negative feedback), but a significantly increased tendency for older adults relative to younger adults to commit set loss errors (i.e., to switch away from a rule despite positive feedback). We fit an existing neurocomputational model of the task to the experimental data by searching through the models parameter space in order to find the best set of parameter values for the two different age groups. This leads to a proposition regarding the effect of aging on the value of the epsilon_ctx parameter, which we argue elsewhere reflects cortical dopamine concentration. We further reanalyse the data by clustering participants by performance (rather than by age) and show that there are multiple points in parameter space that fit each cluster of participants. We argue on the basis of this and the behavioural data, that different parameter values reflect different solutions to optimizing task performance, and that older participants may compensate for changes in epsilon_ctx (reflecting dopamine concentration) by effortful changes in other parameters (specifically, by increasing attentional focus).